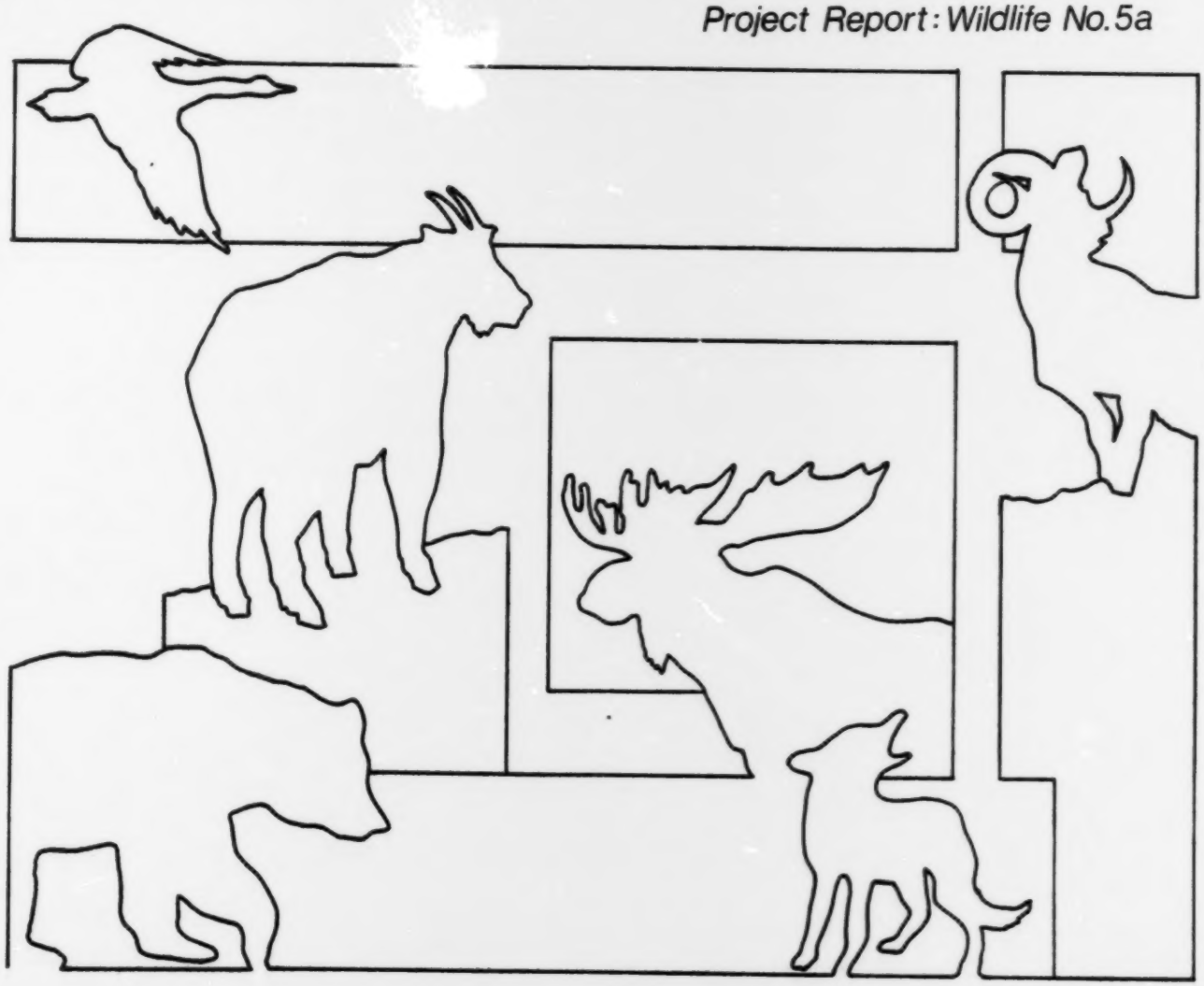
WILDLIFE

Inventory of Canada Geese and Other Waterfowl on the Stewart Pelly and Big Salmon Rivers of the Yukon River Basin

Project Report: Wildlife No. 5a



YUKON RIVER BASIN STUDY

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Canadian Wildlife Service
Pacific and Yukon Region

INVENTORY OF CANADA GEESE AND OTHER WATERFOWL ON THE STEWART, PELLY AND BIG SALMON RIVERS OF THE YUKON RIVER BASIN

June - August 1982

by

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SUMMARY

Investigations of Canada Geese and other waterfowl on rivers of the Yukon River Basin were conducted from mid June to early August in 1982. The Stewart, Pelly and Big Salmon Rivers were surveyed by air in early June. The Pelly and Big Salmon Rivers were further surveyed twice on the ground, in June through August and the Stewart by air in mid-August for breeding, brood-rearing and moulting Canada Geese and other waterfowl.

Briefly, the study objectives were:

1. to assess the distribution and abundance of Canada Geese and other waterfowl on the rivers and associated wetlands;
2. to identify and describe areas of the rivers important to Canada Geese and other waterfowl.

Canada Geese were concentrated on the Stewart River between Fraser Falls and the mouth of the Lansing River. They concentrated along the Pelly River from the MacMillan River to the Earn River.

Maximum recorded numbers of Canada Geese occurred on the Stewart (482) and Pelly River (109) during early August. These populations represented densities of 0.85 and 0.32 geese/km of river surveyed on the Stewart and Pelly Rivers respectively. Only 4 geese were observed on the Big Salmon River, however, from the numbers of tracks and moulted feathers a maximum of 10-15 geese occurred there during late July.

Canada Geese successfully breed on the Stewart River (1 pair, 6 young with 4 adults) and may breed on the Big Salmon River. There was no evidence of breeding on the Pelly River.

The Stewart and Pelly Rivers may be important areas for moulting

and non-breeding Canada Geese from a local population of breeding geese. This hypothesis needs further investigation.

Ninety percent of the non-breeding flocks of geese observed on the Pelly and Stewart Rivers were associated with backwaters and shore bars. Backwaters and shore bars provide geese with safe terrestrial loafing and feeding areas with good visibility, adjacent calm waters for escape from potential predators and high quality forage in the form of new growth horsetails, Equisetum spp. The existence of these areas depends on high spring water levels and seasonal summer decreases of the water level.

Breeding duck density was estimated at 44.3 pairs/km^2 of total water area from 36 wetlands in the Pelly River valley and 15.3 pairs/km^2 from 37 wetlands in the Big Salmon River valley. In both river systems Lesser Scaup was the most abundant and the ubiquitous breeding pair species.

Duck brood density was estimated at 38.3 broods/km^2 of total water area of sampled wetlands in the Pelly River valley and 26.1 broods/km^2 in the Big Salmon River valley. American Wigeon and Bufflehead broods were the most prevalent brood species on the Pelly River while Mallard, Bufflehead, Green-winged Teal and American Wigeon broods were similarly abundant in the Big Salmon River valley.

Non-breeding ducks in the Pelly River valley had an estimated average density of 65.7 birds/km^2 and in the Big Salmon River valley, 43.5 birds/km^2.

River channels, bars and backwaters were used by significant numbers of non-breeding waterfowl for loafing and by Common Mergansers for nesting and brood-rearing.

Most of the sampled wetlands (53%) in the Pelly River valley were shallow waters while most wetlands in the Big Salmon River valley (49%) were marshes. One third of the wetlands of each river system were typed as sedge dominated wetlands. However, the distribution of waterfowl species among the classified and typed wetlands did not differ significantly from the proportional distribution of these classes and types. Hence, the classification is not sufficient criteria for mapping waterfowl abundance and distribution at the species level.

Equisetum fluviatile, Carex rostrata, Carex aquatilis and Hippuris vulgaris were the predominant species of emergent hydrophytes among the wetlands sampled in both river valleys.

Results of the Wilcoxon Rank Sum Test differ between river systems but suggest that Green-winged Teal are influenced by the area of the wetland, area of open water and shoreline length; Mallard are influenced by the area of open water; and Ring-necked Duck are influenced by the area of wetland, area of open water and area of emergents.

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INTRODUCTION

The Yukon River is the largest and most significant river system in the Yukon Territory, draining 246,050 square kilometers or 46% of the territory. Its headwaters are a network of large lakes in the southern Yukon and northern British Columbia. The river's tributaries in the east flow from the Selwyn Mountains and those in the west carry meltwaters from the St. Elias Mountains.

The Yukon River Basin is rich in resources. Its history of resource exploitation extends back beyond the gold rush of 1898 and has expanded to its current use which includes large and small scale mining operations, hydro-electric development, commercial fishing and trapping and recreation.

During 1978 a federal, provincial and territorial task force attempted to assess the potential water use conflicts within the Yukon River Basin. The task force identified many areas of concern but found a critical lack of information pertaining to the biological, physical and socio-economic environment of the Yukon River Basin. Without sufficient baseline information in these areas, management decisions regarding multiple uses of the river system are limited.

One of the concerns addressed by the Work Group of the Yukon River Basin Study Committee was the need for inventory studies of waterfowl utilizing the larger river systems within the Yukon River Basin. Hartman and Hayes (1980) expressed concern over the loss of riparian habitat in the Yukon which could jeopardize the productivity of a population of Canada Geese (*Branta canadensis*). The Canadian Wildlife Service (1981) and Theberge *et al* (1980) identified portions of river systems within the basin as potentially important waterfowl breeding areas and suggested conducting ground surveys to verify the significance of these areas. Within the concerns of the Yukon River Basin Study, Northern Biomes Ltd. was contracted by the Canadian Wildlife Service to conduct inventory studies of waterfowl within the basin.

Few published studies exist on the distribution and abundance of breeding Canada Geese and other waterfowl in the Yukon River Basin east of the Alaskan border. Rand (1946) summarized the historical records and studies concerning waterfowl in the Yukon and added his own notes on the distribution of waterfowl observed along the Canol Road during the summer of 1944. Soper (1954) conducted a summer survey of waterfowl in the south and central Yukon, however, his study adds little to Rand's earlier work. Although waterfowl studies have been conducted within the Yukon River Basin most were related to specific hydro and pipeline developments (Sigma Resource Consultants Ltd. 1975, Canadian Wildlife Service 1979, Anweiler and Blood 1981). No intensive systematic ground surveys for waterfowl have been conducted along any of the major river systems within the basin.

This study presents the results from the first year of a two year program designed to inventory the distribution, abundance and habitat of Canada Geese and other waterfowl utilizing river systems within the Yukon River Basin. Specifically, the objectives of this year's study were to:

1. Document nesting, brood-rearing and moulting areas for Canada Geese and other waterfowl on the Stewart, Pelly and Big Salmon Rivers.

2. Define the biophysical features of nesting, brood-rearing and moulting habitat of Canada Geese and other waterfowl on the Pelly and Big Salmon Rivers.

3. Record all incidental observations of raptors and other wildlife occurring within the three river systems.

The inventory program will continue in 1983 on other river systems within the basin. Results from next year's program may alter some of the conclusions presented in the summary section of this final report.

STUDY AREA

The study area is situated in the central Yukon Territory (60°0' - 63°30' N and 133°0' - 139°30' W) and includes the river valley floodplains of the Stewart, Pelly and Big Salmon Rivers (Figure 1). The Stewart and Pelly Rivers are similarly large river systems and are major tributaries of the Yukon River while the Big Salmon River drains a comparatively smaller area.

A major geological upheaval of the St. Elias and Coast Mountains in the southwest Yukon changed the flow of water from the central Yukon which was drained directly to the southwest coast, to a less direct northwest route of today by the Yukon River (Tempelman - Kluit 1980). This change in flow direction differentially affected portions of the Stewart and Pelly Rivers and to a lesser extent, the upper and lower Big Salmon River. For example, Fraser Falls on the Stewart River and Granite Canyon on the Pelly River (Figure 1) each represent places of change in the respective river's direction and course of flow (Tempelman - Kluit 1980).

The Yukon Plateau of the Western Cordillera extends throughout the glaciated area (Bostock 1948). A major physiographic feature in the study area is the Tintina Trench which extends from the Liard Plain in the southeast Yukon Territory northwest into Alaska. The Stewart River flows through the trench for 100 km from Stewart Crossing to past the mouth of the McQuesten River and the Pelly River flows through the trench for 275 km from Ross River downriver to the mouth of the Tummel River.

The study area lies within the Boreal Forest Region (Rowe 1972) and spans several Ecoregions; Pelly Mountains, Pelly River, Mayo Lake - Ross River, and Klondike River (Oswald and Senyk 1977). Stands of White Spruce (*Picea glauca*) and Black Spruce (*Picea mariana*)

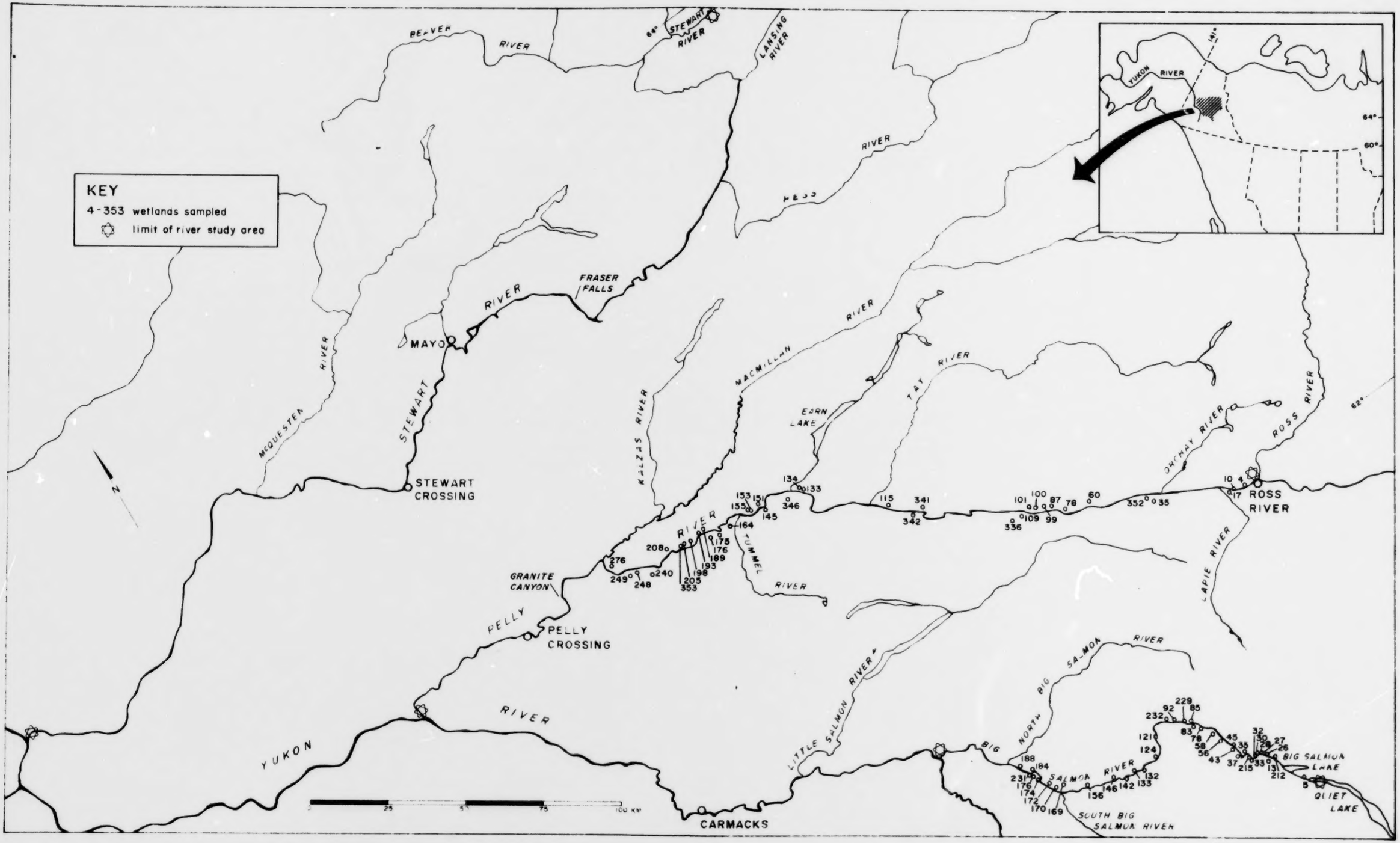

FIGURE 1 Study Area Showing the Limits of the Survey Area and Wetlands Sampled on the Stewart, Pelly and Big Salmon Rivers.

are common throughout the river valleys, Paper Birch (*Betula papyrifera*) is locally abundant and Cottonwood (*Populus balsamifera*) is prevalent in the flooded areas. Permafrost is discontinuous yet widespread (Oswald and Senyk 1977).

Stewart River

The Stewart River flows westerly from its source in the Selwyn Mountains at 2,134 metres elevation over 644 kilometres to its confluence with the Yukon River, draining an area of 51,593 square kilometres (Government of Canada 1968). No narrower than 150 metres, the river has an average current of 5 km/hr, varying with the stretch of river and presence of river bars. Oxbows and silt bars are numerous upriver of Mayo (240 km from mouth of Stewart River). Over 900 floodplain wetlands occur in the Stewart River valley with the majority occurring between the McQuesten River mouth (140 km from mouth of Stewart River) and the Hess River mouth (350 km from mouth of Stewart River). The volume of river flow is greatest in June with an average volume of 58,300 c.f.s. and reducing to 22,800 c.f.s. by August (Sigma Resource Consultants Ltd. 1975). Reduced flow in the summer exposes bars and shore area, areas at which Canada Geese concentrate.

Pelly River

The Pelly River also arises from the Selwyn Mountains. Draining an area of 51,800 square kilometres, the river flows over 700 kilometres until its confluence with the Yukon River (Government of Canada 1968). Aerial surveys of the Pelly River extended from Ross River (450 km from the Pelly's mouth) downriver to the Pelly's confluence with the Yukon River, while ground surveys were conducted from Ross River to Pelly Crossing (70 km from the river's mouth). The Pelly River valley below Ross River is approximately 2 km wide. Between Granite Canyon and Pelly Crossing the river valley narrows and

is confined to the river's width. Glacial marginal channels are common along the sides of the Pelly River valley (Government of Canada 1968). Over 350 wetlands lie in the Pelly River valley (surveyed area) of which 78% are situated upriver of the confluence of the Macmillan River. Streamflow measured at Pelly Crossing is greatest in June with an average flow of 51,000 c.f.s. which drops to 26,600 c.f.s. in July and 17,500 c.f.s. in August (Sigma Resource Consultants Ltd. 1975). These water level changes expose gravel and silt bars, braiding the river channel.

Big Salmon River

The Big Salmon River flows from a chain of lakes 275 kilometres to its confluence with the Yukon River, draining an area of 6,850 square kilometres (Government of Canada 1968). The river's width varies from 30-100 metres while the valley width averages one kilometre upriver of the mouth of the South Big Salmon River (50 km from river's mouth) and 1.7 kilometres downriver of this point.

The upper Big Salmon River is swift flowing water through tight meanders. The riverbanks are usually low, sweepers (overhanging trees) are common on outside curves and there is little area for lentic (calm) sidewaters. The river is generally shallow (2-3 m) with a swift current and numerous sand and gravel bars. Seasonal spring floods, evident along the river's banks flooded many of the floodplain wetlands in the spring of 1982. Of the 230 wetlands identified in the Big Salmon River valley, most are upriver of the confluence of the North Big Salmon River. Peak streamflow occurs in June with a rate of 7,830 c.f.s., decreases to 4,850 c.f.s. in July and continues to decrease in smaller increments throughout the summer (Sigma Resource Consulting Ltd. 1975).

WEATHER

The climate of the study area is continental, with a mean annual temperature in Mayo (on the Stewart River) of -4°C (Oswald and Senyk 1977). The mean daily temperature in June and July is 13.4°C and 15°C respectively, at both Faro and Mayo (Atmospheric Environment Service).

Spring break-up in 1982 was uniquely late. King and Conant (1982) conducting annual spring waterfowl surveys in Alaska and the northern Yukon in 1982, reported lakes were frozen one to three weeks longer than usual. However, by June the mean daily temperature in 1982 at Faro was normal and was 1°C above the 19 year mean at Mayo (Atmospheric Environment Service). The amount of rainfall in June 1982 was well below the 19 year norm and in July was above the recorded norm (Atmospheric Environment Service).

METHODS

Aerial Surveys

Prior to aerial reconnaissance flights of the Stewart, Pelly and Big Salmon Rivers, 1:25,000 scale, stereoscopic pairs of aerial photographs of the river systems were studied. All wetlands within the floodplains of each river valley were delineated and assigned a unique number. The river floodplain refers to that area having the potential to be flooded by the river's waters, either seasonally or during extreme, infrequent high waters, and can be defined topographically. Wetlands within the floodplain were caused by fluvial action.

The enumerated wetlands which contained standing water, were classified according to their basin morphology into: oxbows, ribbons, old channels, shallow waters, backwaters and deep waters. Any wetlands containing no standing water during the aerial surveys were excluded from the study.

Aerial reconnaissance surveys were flown over the three river valley corridors to survey floodplain wetlands and river channels for evidence of Canada Geese and other waterfowl and to assess the reliability of the wetland classification, making appropriate changes in flight. Aerial surveys were flown at 40 m agl and 120 kph in a Maule fixed-wing aircraft with a front seat navigator, pilot and one backseat observer. Observations of Canada Geese and other waterfowl were plotted on the aerial photographs, and any changes in the status of wetlands was recorded onto cassette tape.

The study area of each river (Figure 1) was flown once between 10 and 13 June. All wetlands and river channels were surveyed in the Pelly and Big Salmon River Valleys. However, for logistical reasons, only 200 randomly selected wetlands of the 900 identified on the Stewart River were sampled. All of the main river channels of the Stewart River were surveyed. The Stewart River was surveyed a second time, 14-15 August for evidence of brood-rearing or moulting Canada Geese.

Ground Surveys

Once corrections were made to wetland classifications based on the findings of the aerial reconnaissance, a random sample of wetlands was drawn from each basin morphology class. The size of each sample was proportional to the class size. A total of 36 wetlands were sampled on the Pelly River and 37 on the Big Salmon River.

Due to the late spring break-up, breeding pair surveys of Canada Geese and other waterfowl were conducted on the Pelly River from 14 to 25 June and on the Big Salmon River from 27 June to 5 July. Waterfowl brood-rearing ground surveys were conducted at the same wetlands as the breeding pair inventory, from 17 to 15 July on the Big Salmon River and from 3 to 10 August on the Pelly River. River travel by the 3-person crew was in a motor equipped freighter canoe.

Breeding Pair and Brood Inventory

The location of Canada Geese on the river channels, their behaviour (feeding or loafing), group type (pair, family, non-breeder), group size and moult condition where applicable were recorded. Their immediate habitat was described by the vegetation present and the area's morphological association with the river (vegetated bar, mudflat, backwater, shore bar).

Breeding pair counts of ducks were conducted mainly between 0430 and 1030 hours though cold damp weather or river logistics often necessitated evening sampling hours from 1800 to 2130. Waterfowl observations were primarily made by one observer who walked through the emergent vegetation zone or along the shore of each wetland. Larger wetlands required two observers to walk the periphery. Binoculars or a spotting scope (8x-40x) were used for waterfowl identifications. Using some of the conventions of Dzubin (1969) a breeding pair was identified by: a lone pair, a lone drake or a hen flushed from a nest (given no lone drake of the same species was also censused as her mate). A lone hen otherwise was not considered as a breeder. The lateness of spring break-up in 1982 complicated the arrival of waterfowl to their breeding grounds and subsequent breeding. Ducks in groups of three or more birds (which were not obvious pairs) could not be positively identified as breeders and so were considered non-breeders. The exclusion of lone hens as breeders may have underestimated breeding pair numbers with certain species.

Brood counts were conducted throughout the daylight hours. Wetlands were censused for broods using similar methods to the breeding pair inventories. The size of the brood, the approximate age of the young and the brood's habitat associations were recorded.

All other birds found associated with the river channels and wetlands were recorded as well as mammal sitings.

Habitat Inventory

Waterfowl wetland habitat was described for individual species in two different ways. The first method of habitat description was general and employed a classification scheme of the wetlands into predefined categories. The purpose of this method was to test the applicability of this classification scheme to waterfowl habitat use and thus test its capabilities in the mapping and extrapolation of waterfowl habitat strictly from maps or aerial photos. The second method of habitat description was to define the wetland by its physical dimensions (area, area of open water, area of emergents, shoreline length and proximity to other wetlands) and to test for correlations of each parameter with waterfowl use on a species level. The relative productivity of each wetland as defined by the abundance of aquatic plants and invertebrates was sampled but the analysis is beyond the scope of this project and will be presented elsewhere.

The classification scheme of defining the wetlands involved a hierarchy. Wetlands were first organized into groups (prior to the aerial survey) based on their basin morphology, then into wetland classes based on the inter-relationship of ponded water and the vegetation and then into wetland types based on their predominant vegetation lifeforms and the respective species. The organization of wetlands into classes and types follows the Canadian Wetland Registry (Zoltai 1980).

This wetland classification system is general and for national use. It accommodates the different types of northern boreal wetlands whereas many wetland classification schemes designed for the prairie wetlands use criteria inapplicable to northern systems. A few additions to the classifications of Zoltai (1980) adapted the Registry to our needs.

Wetlands were classified into wetland classes as: bog, fen, marsh, shallow water or lake on the basis of vegetation and life-forms and in the case of shallow water and lake on size, depth and area of

open water. A bog was recognized by the presence of peat, predominantly sphagnum, and ericaceous shrubs, a high water table at or near the surface and its acidity. A fen was identified by the presence of peat and the predominance of sedges, grasses and brown mosses with scant shrub or tree cover. A marsh was recognized by evidence of periodical inundation by standing or slow moving water. It is best described as a mosaic surface pattern of vegetation comprised of unconsolidated grass and sedge sods, frequently interspersed with channels or pools of open water. Sedges and grasses are the predominant vegetation of a marsh with submerged and floating aquatic hydrophytes in the open water areas. A shallow water is semi-permanent to permanent standing or slow moving water with relatively large and stable expanses of open water. The shallow water class includes ponds, pools, sloughs, shallow lakes, oxbows, and channels. Shallow waters are generally no deeper than 2 m and the open water zone may exceed 8 ha in size while those basins less than 8 ha in area must have 75% or more of that area occupied by the open water area. Emergent vegetation is scant and may include trees. To this classification scheme we added lakes. A lake is a waterbody exceeding 8 ha in size, deeper than 2 m and with few to no emergents. Wetlands were further defined into wetland types by their predominant vegetation lifeform (ie. shrub, moss, sedge, grass, etc.).

The area of each wetland was estimated from the 1:25,000 scale aerial photographs using a dot grid. The area of open water and the area of emergents were visually estimated as a percent of the total area of the wetland and later converted to hectares. Shoreline length was measured from aerial photographs. The index of proximity of wetlands represents the mean value of three measurements of distance to the three nearest neighbouring wetlands.

The vegetation of each wetland was sampled by lifeform zone: submergent, emergent, shrub and tree. Species present and a visual estimate of their percent cover were recorded. Sedges, grasses and all unknown plant species were verified by the Ottawa Biosystematics Laboratory. Plant nomenclature follows Porsild and Cody (1980).

RESULTS

Since the emphasis of this study is on Canada Geese, the results are presented in sections dealing only with Canada Geese, then sections dealing with other waterfowl. When discussing Canada Geese, for each river system the results of the aerial and ground surveys are presented chronologically. When discussing other waterfowl species, the results of both ground surveys are combined in the presentations of densities and habitat use on each river system.

Notes on raptors and raptor nest sites taken incidental to the waterfowl survey are summarized in Appendix 1. Observations of all birds including waterfowl and raptors are presented in Appendix 2. Incidental observations of mammals are presented in Appendix 3. Observations of waterfowl other than Canada Geese observed on the aerial survey of the Stewart River are presented in Appendix 4.

Canada Geese

Stewart River

Early Survey (Aerial):

The majority of the Canada Geese observed along the Stewart River during the aerial survey of 12 - 13 June were concentrated along the mainstream channels. Only one pair of geese was noted on the 200 randomly sampled wetlands located throughout the Stewart River valley. This pair, located on a small slough upriver of Fraser Falls, was the only indication of breeding observed along the entire length of the Stewart River, from 10 km upriver of the Beaver River to the confluence of the Stewart and Yukon Rivers.

The distribution of the 64 Canada Geese observed along the mainstream of the Stewart River was rather skewed, 7 of the 8 groups or 90% of the total geese occurred upriver of Fraser Falls (Figure 2).

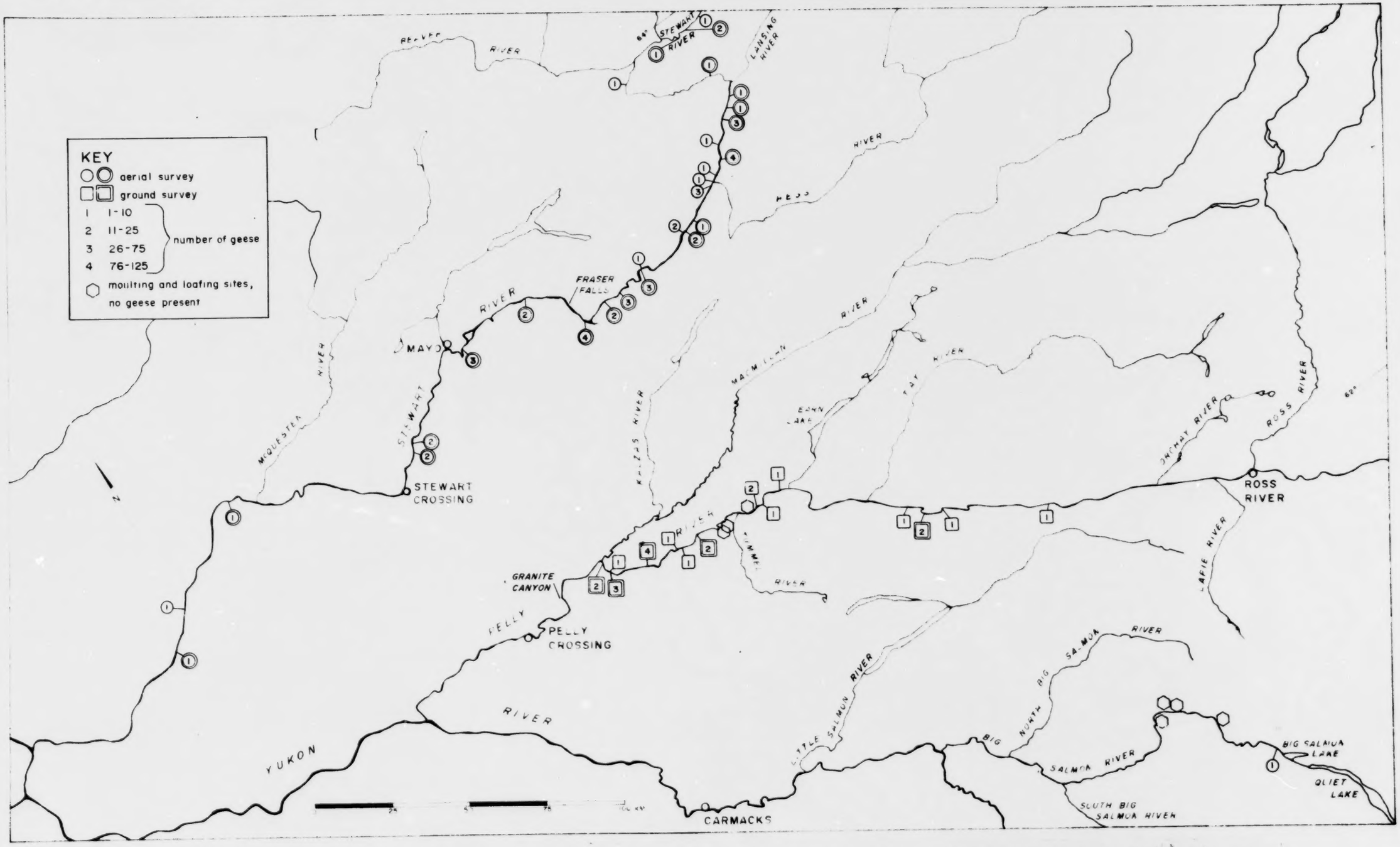

FIGURE 2 Distribution and Number of Canada Geese Observed on the Stewart, Pelly and Big Salmon Rivers During Aerial and Ground Surveys, June - August, 1982. Single circle is 11-13 June survey; double circle is 13-14 August survey; single square is 14-21 June survey; double square is 3-11 August survey.

Group sizes ranged from one to 27 individuals with a mean group size of 8.3 geese. The population density of Canada Geese in the Stewart River area was 0.12 geese/km of river (Table 1).

Geese were predominantly associated with backwaters which are located at major river bends and along the slower moving reaches of the river (Table 2). Geese were observed either standing on mudflats adjacent to, or swimming on the slower moving backwaters. Although geese were observed either swimming or standing on shore, all were capable of flight as they flushed ahead of the approaching aircraft. Although we present no correction factor for unobserved geese, the probability of missing geese during the aerial survey was likely low. Geese which could have been missed would have been small groups standing on the shore.

Late Survey (Aerial):

During the second aerial survey of the Stewart River valley from 14 - 15 August, the survey effort was concentrated along the mainstream channels where the majority of geese were located in June.

A total of 482 Canada Geese in 19 groups was recorded along the river's length from 10 km upriver of the Beaver River mouth, downriver to the mouth of the Stewart River. Mean group size increased from 8.3 on the June survey to 25.4 on this survey (Table 1), while density increased from 0.12 to 0.85 geese per km of river. Although Canada Geese were slightly more scattered in their distribution in August than in June, over 90% still occurred upriver of Mayo with the highest concentration between Fraser Falls and the Lansing River (Figure 2). All geese, other than one family group, consisting of four adults and 6 young (1/2 adult size) were non-breeders capable of flight. The one family group, (located near the Beaver River) represented the only sign of successful nesting on any of the three river systems surveyed.

TABLE 1 Total Number, Group Size and Relative Density of Canada Geese Observed During Aerial and Ground Surveys of the Stewart, Pelly and Big Salmon Rivers, June - August 1982

	STEWART RIVER		PELLY RIVER			BIG SALMON RIVER		
	Aerial Survey		Aerial Survey	Ground Survey		Aerial Survey	Ground Survey	
	June 12-13	Aug 14-15	Jun 11	Jun 14-24	Aug 3-10	Jun 10	Jun 26-Jul 5	Jul 17-25
Total Number	66*	482	0	46	109	4	0	0
Total Groups	8	19	0	9	5	1	0	4†
Mean Group Size	8.3	25.4	0	5.1	21.8	4	0	
Range of Group Size	1-27	4-103	0	1-11	13-43	0	0	0
River Length Surveyed (Km)	565	565	396	340	340	215	215	215
Geese/Km of River Surveyed	0.12	0.85	0	0.14	0.32	0.02	0	0

* Includes one family group of 4 adults and 6 young.

† Evidence of geese only (tracks, moulted feathers, feces).

TABLE 2 Total Number of Canada Geese Occurring by Habitat Type During Aerial and Ground Surveys of the Stewart, Pelly and Big Salmon Rivers, June - August 1982. Brackets represent percent occurrence by habitat type for each survey period.

		BACKWATERS	SHORE BARS	ISLAND BARS	LAKES	RIVER CHANNEL
Stewart River	†June 12-13	58 (87.9)	0	5 (7.6)	2 (3.0)	1 (1.5)
	†Aug 14-15	238 (54.2)	145 (33.0)	15 (3.4)	0	41 (9.4)
Pelly River	†June 14-24	42 (95.5)	2 (4.5)			
	†Aug 3-10	79 (72.5)	30 (27.5)			
Big Salmon River	†June 10				4 (100.0)	
	†July 17-25	*	*	*	*	
TOTAL		417 (63.0)	177 (26.7)	20 (3.0)	6 (.9)	42 (6.4)

* Evidence only
† Aerial Surveys
+ Ground Surveys

Almost 85% of the geese observed during the August survey were standing on mudflats or swimming in the lagoons of backwaters and adjacent to shore bars (Table 2). Over 65% of the backwaters and shore bars where Canada Geese occurred were extensively vegetated with stands of *Equisetum* and *Carex*. Extensive grazing and cratering was evident at a number of these sites.

Pelly River

Early Survey (Aerial & Ground):

No Canada Geese were observed on either the mainstream channels of the Pelly River or any of the 353 wetlands surveyed within the river valley, during the aerial survey of 11 June. However, during the ground surveys of 14 - 24 June a total of 46 Canada Geese in 9 groups was observed. The mean group size was 5.1 ranging from 1 - 11 individuals. The population density was 0.14 geese per km of river (Table 1). All of these small groups of non-breeders were restricted to the main channels of the river between the MacMillan and Earn River mouths and upriver of the Tay River (Figure 2). Over 95% of the geese were associated with backwaters (Table 2) and all of the geese were capable of flight.

Late Survey (Ground):

During the second ground survey of 3 - 10 August, 109 geese in 5 groups were present on the river (Table 1). Mean group size increased 4 fold from the June to August survey while the density of Canada Geese more than doubled (Table 1). Other than one group of 13 geese upriver of the confluence of the Tay River all geese were associated with the main channels of the Pelly River between the Tummel and Macmillan Rivers (Figure 2). Although all geese observed were capable of flight, there was evidence of moulting. Many moulted

primaries and secondaries were observed along the mudflats and shore edges of backwater sites from where geese had been flushed. At one backwater site, along the shore edge, the carcass of a Canada Goose was found with primaries extending only 5 - 8 cm out of their sheaths. Tracks in the vicinity of the carcass were bear.

Habitat types used by Canada Geese during the first and second surveys were similar. During both survey periods, only backwaters and shore bars were utilized by geese and, combining the data from both surveys, approximately 80% of all geese occurred on backwaters. The most frequently occurring and abundant plant recorded at eight backwater and shore bar sites examined was horsetail, *Equisetum fluviatile* and *E. pratense* (Table 3). These species grew in extensive mats extending from the highwater mark back into the bordering willows *Salix* spp and Cottonwood. Grasses and sedges were also encountered at the sites though less frequently and in less abundance (Table 3). With both species of *Equisetum* there was evidence of heavy grazing of the aerial stems and cratering for rhizomes by Canada Geese. Goose feeding activity was especially evident in areas of new growth *Equisetum* along receding waterlines. Geese apparently also grazed on new growth of *Deschampsia caespitosa* and *Carex* spp.

Big Salmon River

Only one group of four Canada Geese was observed in the Big Salmon River valley during the aerial survey of 10 June (Figure 2). No geese were observed during either of the ground surveys, however evidence of moulting and loafing Canada Geese was present on the second ground survey of 17 - 25 July. Moulted primaries and secondaries were noted along the shores of a lake (#85) adjacent to the river and at three other river channel sites (Table 2), suggesting 10 - 15 geese along the entire length of the river. Geese at the lake site had grazed heavily on aerial stems of *Equisetum* growing along the shore and to a lesser extent on *Carex aquatilis* stems.

TABLE 3 Relative Frequency of Plant Species Occurring on Shore Sites Utilized by Canada Geese on the Pelly River, 3-10 August 1982.

PLANT SPECIES	RELATIVE FREQUENCY
**Equisetum fluviatile*	25
**E. pratense*	63
**E.* spp.	100
Agropyron violaceum	38
Arctophila fulva	38
Calamagrostis canadensis	25
Hordeum jubatum	13
**Deschampsia caespitosa*	25
**Carex aquatilis*	25
C. rostrata	13
Eleocharis acicularis	13
Populus balsamifera	88
Salix spp.	75

* Grazed plants, presumably by Canada Geese.

Other Waterfowl

Pelly River

Waterfowl occurred on the main channels of the Pelly River as non-breeding individuals or in flocks but rarely as breeding pairs or broods. Common Merganser was the only species which used the active river channel for breeding as indicated by hole nests in cutbanks and broods on the channels. Eight species of waterbirds (excluding Canada Geese) were recorded on the Pelly River channels; 2 loon species, 4 species of dabblers and 2 species of divers (Table 4). Waterfowl use of the main channels was greater in mid-June (379 birds) than in early August (95 birds). American Wigeon and Mallard were the most abundant species recorded during mid-June while Common Merganser and American Wigeon were the most abundant species in August.

Among the 36 wetlands sampled within the Pelly River valley, 15 species of waterbirds recorded as pairs, broods or assumed non-breeders were observed: 2 loon species, 2 grebe species, 6 species of dabblers and 5 diver species (Table 5). Lesser Scaup was the ubiquitous waterfowl species recorded as pairs, occurring on 36% of the wetlands. Ring-necked Duck and Green-winged Teal pairs were also common. Bufflehead was the ubiquitous brood species, occurring on 45% of the wetlands.

All the waterfowl population densities are calculated as number/km^2 of total water area which includes the area of emergents plus the area of open water within the wetland. The estimated density of duck pairs within the Pelly River valley was 44.2 pairs/km^2 in which Lesser Scaup and American Wigeon were the most abundant species (Table 6). While more species of dabbling ducks were recorded than species of diving ducks, the density of diving ducks (24.0 pairs/km^2) was slightly higher than that of dabbling ducks (20.3 pairs/km^2).

TABLE 4 Number of Waterfowl (other than geese) Observed on the Main Channels of the Pelly and Big Salmon Rivers During Ground Surveys, June - August 1982. Totals refer to adult birds, brackets indicate birds/km of river channel surveyed; Pelly River = 340 Km Big Salmon = 215 Km.

	PELLY RIVER			BIG SALMON RIVER		
	June 14-23	Aug. 2-10		June 26-July 5	July 17-25	
	TOTAL BIRDS	TOTAL BIRDS	NUMBER OF BROODS	TOTAL BIRDS	TOTAL BIRDS	NUMBER OF BROODS
Red-throated Loon	1(<0.01)	4(0.01)		6(0.03)	2(0.01)	
Arctic Loon		3(0.01)		3(0.01)	1(<0.01)	
Common Loon				1(<0.01)	2(0.01)	
Green-winged Teal	16(0.05)			7(0.03)		1(<0.01)
Mallard	157(0.46)					
Northern Pintail	9(0.03)					
American Wigeon	174(0.51)	62(0.18)				
Harlequin Duck				1(<0.01)	1(<0.01)	
Common Goldeneye				5(0.02)	5(0.02)	
Barrow's Goldeneye				2(0.01)		
Bufflehead	3(0.01)			14(0.07)	2(0.01)	
Common Merganser	19(0.06)	26(0.08)	6(0.02)	43(0.2)	32(0.15)	10(0.05)
TOTAL	379(1.13)	95(0.28)	6(0.02)	82(0.39)	45(0.22)	11(0.06)

TABLE 5 Pelly River - Frequency of Occurrence of Waterbirds on 36 Wetlands Surveyed, June-August 1982. One pair, brood or non-breeder was assigned to a wetland if one or more pair(s), brood(s) or non-breeder(s) respectively were recorded there.

SPECIES	% FREQUENCY OF OCCURRENCE			
	PAIRS	BROODS	NON-BREEDERS (14-24 June)	NON-BREEDERS (3-10 August)
Red-throated Loon	3			
Arctic Loon	6			7
Horned Grebe	8	10		
Red-necked Grebe	6	7		
Green-winged Teal	22	28	8	10
Mallard	17	31	22	24
Northern Pintail	8		3	
Blue-winged Teal	17	3	3	7
Northern Shoveler	3		3	3
American Wigeon	19	31	8	14
Ring-necked Duck	25	17	11	17
Lesser Scaup	36	11	8	21
Common Goldeneye		3	8	
Barrow's Goldeneye			6	
Bufflehead	19	45	19	

TABLE 6 Pelly River - Number of Pairs, Broods and Non-Breeding Dabbling and Diving Ducks Recorded During Ground Surveys of 36 Wetlands, June-August 1982. Total water area = total area of emergents plus total open water area of all wetlands surveyed.

SPECIES	NUMBER OF PAIRS	PAIRS/Km^2 TOTAL WATER AREA	NUMBER OF BROODS	BROODS/Km^2 TOTAL WATER AREA	NUMBER OF NON-BREEDERS	NON-BREEDERS/Km^2 TOTAL WATER AREA*
Green-winged Teal	9	4.8	10	5.3	48	12.8
Mallard	8	4.2	10	5.3	31	8.3
Pintail	3	1.6	0	0	1	0.3
Blue-winged Teal	5	2.7	1	0.5	13	3.5
Northern Shoveler	2	1.1	0	0	2	0.5
American Wigeon	11	5.9	21	11.2	33	8.8
Ring-necked Duck	10	5.3	6	3.2	64	17.1
Lesser Scaup	26	13.9	4	2.1	22	5.9
Common Goldeneye	0	0	1	0.5	5	1.3
Barrow's Goldeneye	0	0	0	0	2	0.5
Bufflehead	9	4.8	19	10.2	25	6.7
TOTAL	83	44.3	72	38.3	246	65.7

* average of two surveys

Duck brood density was estimated at 38.4 broods/km^2; American Wigeon and Bufflehead broods were most abundant (Table 6). Two species, Northern Pintail and Northern Shoveler recorded as pairs were not observed with broods while Lesser Scaup, the most abundant (26 pairs) pair species was only recorded with broods on four occasions. The brood densities of dabbling ducks (22.3 broods/km^2) was much higher than that of diving ducks (16.0 broods/km^2). The mean number of young per brood for each species is presented in Appendix 5.

Many waterfowl other than breeding pairs or broods were recorded on the wetlands. These non-breeding ducks occurred most often in flocks and were predominantly male. Ring-necked Duck was the most abundant species as a non-breeder although Green-winged Teal, American Wigeon and Mallard were also numerous (Table 6). Overall, the population density of non-breeding ducks was estimated at 65.7 non-breeders/km^2. For every species other than Northern Pintail, Lesser Scaup and Northern Shoveler, the abundance of non-breeders was higher than the respective pair or brood abundance.

Big Salmon River

Waterfowl were commonly recorded along the main channel of the Big Salmon River though in no great abundance. One species of dabbling duck, five species of diving ducks and three species of loon were recorded (Table 4). Except for the ubiquitous and abundant Common Merganser (hens and broods) and one brood of Green-winged Teal, no other waterfowl breeding and brood-rearing on the river channel were observed. The Big Salmon River supported more Common Merganser broods (10) than the Pelly River (6).

Among the 37 wetlands surveyed in the Big Salmon River valley, 10 species of waterfowl were recorded: 1 species of swan, four species of dabbling ducks and five species of diving ducks plus two

species each of loons and grebes (Table 7). Lesser Scaup pairs were most common occurring on 19% of the wetlands. However, scaup broods were comparatively much less common. Broods of Green-winged Teal, Mallard, American Wigeon and Bufflehead were most common among the surveyed wetlands yet breeding pairs of these same species were less commonly observed. Groups of non-breeding waterfowl were most common during the late June survey and were largely Mallard and Lesser Scaup.

In the wetlands of the Big Salmon River valley, the waterfowl breeding pair density was 15.3 pairs/km^2, considerably less than the duck pair density estimated for the Pelly River. Lesser Scaup and Mallard were the most abundant pair species recorded (Table 8). The breeding pair density of dabbling ducks (5.1 pairs/km^2) was considerably less than that of diving ducks (10.2 pairs/km^2). However, there were twice as many diving duck species recorded as pairs as there were dabbling duck species recorded as pairs.

Almost twice as many waterfowl broods as pairs were recorded on the wetlands (Table 8). Overall, the density of duck broods was 26.1 broods/km^2 with Mallard, Green-winged Teal, American Wigeon and Bufflehead the most abundant species. In contrast to pairs, the density of dabbling duck broods (16.5 broods/km^2) was higher than the brood density of diving ducks (9.6 broods/km^2).

Non-breeding ducks occurring on the Big Salmon River wetlands averaged 43.5 birds/km^2 with almost half of this total being Ring-necked Ducks. The majority of the 68 Ring-necked Ducks observed were male, occurring in one flock of 44 individuals. Other common non-breeding ducks were Lesser Scaup and Mallard (Table 8). The average density of nonbreeding dabbling ducks (10.2 birds/km^2) was considerably less than that of diving ducks (33.3 birds/km^2).

TABLE 7 Big Salmon River - Frequency of Occurrence of Waterbirds on 37 Wetlands Surveyed, June-July 1982. One pair, brood or non-breeder was assigned to a wetland if one or more pair(s), brood(s) or non-breeder(s) respectively were recorded there.

SPECIES	% FREQUENCY OF OCCURRENCE			
	PAIRS	BROODS	NON-BREEDERS (26 June-5 July)	NON-BREEDERS (17-25 July)
Red-throated Loon	3			
Common Loon	3			3
Horned Grebe	3	3		3
Red-necked Grebe	9			3
Trumpeter Swan	3	3		
Green-winged Teal	6	20	3	11
Mallard	9	29	31	14
Blue-winged Teal			3	
American Wigeon	3	20	6	6
Ring-necked Duck	3	6	13	6
Lesser Scaup	19	3	25	6
Common Goldeneye		6	6	9
Barrow's Goldeneye	3			
Bufflehead	13	29	13	11

TABLE 8 Big Salmon River - Number of Pairs, Broods and Non-Breeding Dabbling and Diving Ducks Recorded During Ground Surveys of 37 Wetlands, June-July 1982. Total water area = total area of emergents plus total open water area, of all wetlands surveyed.

SPECIES	NUMBER OF PAIRS	PAIRS/Km^2 TOTAL WATER AREA	NUMBER OF BROODS	BROODS/Km^2 TOTAL WATER AREA	NUMBER OF NON-BREEDERS	NON-BREEDERS/Km^2 TOTAL WATER AREA*
Green-winged Teal	2	1.3	8	5.1	4	1.3
Mallard	5	3.2	11	7.0	23	7.3
American Wigeon	1	0.6	7	4.4	5	1.6
Ring-necked Duck	2	1.3	2	1.3	68	21.7
Lesser Scaup	10	6.4	1	0.6	19	6.1
Common Goldeneye	0	0	2	1.3	4	1.3
Barrow's Goldeneye	1	0.6	0	0	4	1.3
Bufflehead	3	1.9	10	6.4	9	2.9
TOTAL	24	15.3	41	26.1	136	43.5

* average of two surveys

Habitat Assessment and Waterfowl Use

Wetland Classification

Within the Pelly River valley the distribution of the 36 wetlands on the basis of their wetland class was; 53% as shallow water, 22% as marsh, 17% as fen, 5% as bog and 3% as lake. Apart from American Wigeon, ducks (pairs or broods) did not use the wetland classes out of proportion to their availability (Chi-square test, $P < .05$). Among American Wigeon pairs and broods, 25% were in fens and 75% were in shallow waters, thus wigeon used these two wetland classes out of proportion to their availability.

The distribution of the 36 wetlands in the Pelly River valley on the basis of their wetland type was; 36% as sedge, 22% as sedge and shrub, 14% as moss, 8% as tall shrub, 5% as mixed wood and 3% each of conifer, low shrub, grass, horsetail, and horsetail and sedge. All duck species were distributed among these wetland types in similar proportions to the distribution of the surveyed wetlands among the types ($P<.05$).

Within the Big Salmon River valley the distribution of the 37 wetlands into wetland classes was; 49% as marsh, 27% as shallow water, 13% as lake and 11% as fen. No duck species showed any difference in their distribution ($P < .05$) among the wetland classes to the class availability. The wetlands were distributed into wetland types as; 32% sedge, 24% sedge and shrub, 16% horsetail and sedge, 11% tall shrub, 8% conifer and 3% as low shrub, moss and mixed wood. Again, the distribution of waterfowl species among the wetland types was not significantly different ($P < .05$) from the relative distribution of the wetlands.

Aquatic Plants

A list of all plants recorded in the Pelly and Big Salmon River valleys is presented in Appendix 6.

The most common emergent plant species in the wetlands of the Big Salmon and Pelly River valleys were *Equisetum fluviatile, Carex rostrata, C. aquatilis* and *Hippuris vulgaris* (Table 9). In the Big Salmon River valley both *Carex rostrata* and *Equisetum fluviatile* occurred in more than 67% of the wetlands sampled. In comparison, no more than 50% of the wetlands sampled in the Pelly River valley had these common emergent species. *Carex rostrata* was the predominant emergent in terms of vegetation cover in 22 of 37 (59%) wetlands sampled along the Big Salmon River. In the Pelly River valley *Carex aquatilis* was the dominant species in 36% of the surveyed wetlands, *C. rostrata* was dominant in 19% and *Equisetum fluviatile* and *Eleocharis palustris* were each dominant in 17% of the wetlands. Most of the recorded submergent hydrophytes were common to both river systems (Table 9). *Potamogeton Richardsonii* and *Utricularia vulgaris* occurred in the wetlands of both river valleys with similar high frequency although *Utricularia* was rarely as abundant as *Potamogeton Richardsonii* in a given wetland.

Physical Habitat Parameters

Mean estimates of habitat parameters were slightly larger for the wetlands of the Pelly River than for the wetlands of the Big Salmon River (Table 10). Of the 36 wetlands sampled in the Pelly River valley, 61% had an area of 3 ha or less. Thirty-three percent of the wetlands had 1 ha or less of open water and 66% had no more than 3 ha of open water. Three of the wetlands sampled had no emergent vegetation and 45% had .01 - .1 ha of emergent zone.

TABLE 9 **Frequency of Occurrence of Aquatic Hydrophytes Recorded During Ground Surveys of Wetlands of the Pelly and Big Salmon Rivers, June - August 1982.**

SPECIES	% FREQUENCY OF OCCURRENCE	
	PELLY RIVER n-36	BIG SALMON RIVER n-37
Emergent hydrophytes:		
Equisetum arvense	3	--
E. fluviatile	28	68
Arctophila fulva	6	11
Carex aquatilis	47	41
C. diandra	11	3
C. limosa	3	5
C. physocarpa	6	3
C. rostrata	44	82
Eleocharis acicularis	--	5
E. palustris	17	14
Eriophorum angustifolium	3	--
Scirpus validus	3	3
Calla palustris	6	3
Hippuris vulgaris	50	41
Menyanthes trifoliata	14	8
Floating-leaved hydrophytes:		
Lemna minor	3	--
Polygonum amphibium	14	3
* *Nuphar* spp.	14	8
Submergent hydrophytes:		
Potamogeton alpinus	--	30
P. filiformis	3	3
P. Friesii	14	11
P. gramineus	--	3
P. pectinatus	11	8
P. praelongus	3	3
P. pusillus	14	14
P. Richardsonii	42	41
P. vaginatus	6	11
+ *Sparganium* spp.	14	49
Ranunculus aquatilis	36	19
Callitriche hermaphroditica	6	3
Myriophyllum exalbescens	25	41
M. Verticillatum	--	3
Utricularia vulgaris	31	30
† *Chara* spp.	28	30

* includes *Nuphar polysepalum* and *N. variegatum*
\+ includes *Sparganium angustifolium* and *S. minimum*
† green algae

TABLE 10 Habitat Parameter Estimates of Wetlands Sampled on the Pelly and Big Salmon Rivers, June - August 1982.

HABITAT PARAMETER	PELLY RIVER n = 36		BIG SALMON RIVER n = 37	
	Mean	Range	Mean	Range
Area of wetland (ha)	5.8	.9-40.9	5.0	.9-18.6
Area of open water (ha)	4.6	.1-39.7	4.0	.1-17.6
Area of emergents (ha)	.7	0-6.7	.6	0-2.7
Shoreline length (km)	1.0	.02-5.9	.8	.07-1.8
†Proximity to other wetlands (km)	.5	.2-1.2	.2	.11-.8

† Mean distance to three nearest neighbouring wetlands.

In the Big Salmon River valley, 59% of the 37 wetlands had 3 ha or less of total area. Thirty-nine percent of the wetlands had no greater than 1 ha of open water. One of the wetlands had no emergent vegetation while 44% had .01 - .1 ha of emergents.

Thirty-one percent of the Pelly River wetlands sampled had no waterfowl utilizing them. Four of the largest wetlands (78, 145, 276 and 336, see Figure 1) collectively accounted for 32% of the total pairs and 67% of the total broods recorded. Their large areas ranged from 12 - 40.9 ha and their estimated open water areas ranged from 5 - 39.7 ha. Each of them had at least 1 ha of emergent vegetation which was dominated by sedges and/or horsetails. Wetlands 78, 145 and 276 were river oxbows.

Among the wetlands sampled along the Big Salmon River, 22% were without waterfowl. The two largest wetlands, 26 and 132 (Figure 1) accounted for 43% of the total pairs and 15% of the total broods recorded among the 37 wetlands. Their respective total areas were 19 and 15 ha, areas of open water were 17 and 11 ha and areas of emergent vegetation were .6 and 3.3 ha. The predominant emergent vegetation in both wetlands was *Carex rostrata*.

Correlation coefficients were calculated between the estimated physical habitat parameters and are presented in Table 11. The area of open water was positively correlated with the area of the wetland, shoreline length and proximity to other wetlands. The area of wetland was also positively correlated with shoreline length. What these correlations indicate is that the variables are not independent of each other. Therefore, the effects of a specific parameter on waterfowl habitat use can not be isolated from the influence imposed by correlated parameters.

Among the wetlands sampled in the Pelly River valley, there was a significant association of Green-winged Teal with wetlands with the larger total area, larger open water area and longer shoreline length (Table 12). The mean wetland size on which Green-winged Teal

TABLE 11 Correlation Coefficients Calculated Between Habitat Parameters.

	AREA OF WETLAND (ha)	AREA OF OPEN WATER (ha)	AREA OF EMERGENTS (ha)	SHORELINE LENGTH (km)
Area of wetland (ha)				
Area of open water (ha)	.96 **			
Area of emergents (ha)	.36	.10		
Shoreline length (km)	.75 **	.90 **	.23	
Proximity to other wetlands (km)	.32	.78 **	.28	.31

** P<.01

TABLE 12 Pelly River - Differences in Habitat Parameter Estimates of Wetlands With and Without Pairs and/or Broods, June-August 1982.

HABITAT PARAMETER	WETLANDS WITH PAIRS &/OR BROODS $\bar{X}$	WETLANDS WITHOUT PAIRS &/OR BROODS $\bar{X}$	WILCOXON RANK SUM TEST STATISTIC
Green-winged Teal			
area of wetland (ha)	11.2	2.5	237*
area of open water (ha)	10.5	1.7	246**
area of emergents (ha)	1.3	0.5	188
shoreline length (km)	1.7	0.6	257**
†proximity to other wetlands (km)	0.4	0.5	191
Mallard			
area of wetland (ha)	12.1	2.7	199
area of open water (ha)	10.4	1.8	214**
area of emergents (ha)	1.5	0.4	183
shoreline length (km)	1.7	0.7	196
†proximity to other wetlands (km)	0.6	0.5	193
American Wigeon			
area of wetland (ha)	10.1	3.1	199
area of open water (ha)	8.9	2.4	213
area of emergents (ha)	1.0	0.2	182
shoreline length (km)	1.5	0.7	216
†proximity to other wetlands (km)	0.5	0.4	217
Ring-necked Duck			
area of wetland (ha)	8.3	5.5	302**
area of open water (ha)	5.7	4.9	200**
area of emergents (ha)	1.5	0.2	202**
shoreline length (km)	1.1	1.0	172
†proximity to other wetlands (km)	0.5	1.4	173
Lesser Scaup			
area of wetland (ha)	6.9	6.4	250*
area of open water (ha)	5.1	5.5	231
area of emergents (ha)	1.4	0.3	213
shoreline length (km)	1.1	1.1	225
†proximity to other wetlands (km)	0.4	0.4	205

† Mean distance to three nearest neighbouring wetlands.
* P<.05
** P<.01

... Cont'd.

TABLE 12 - Cont'd.

HABITAT PARAMETER	WETLANDS WITH PAIRS &/OR BROODS $\bar{X}$	WETLANDS WITHOUT PAIRS &/OR BROODS $\bar{X}$	WILCOXON RANK SUM TEST STATISTIC
Bufflehead			
area of wetland (ha)	8.4	4.6	221
area of open water (ha)	7.1	2.1	236
area of emergents (ha)	1.1	0.5	205
shoreline length (km)	1.3	1.0	215
†proximity to other wetlands (km)	0.5	0.4	236

† Mean distance to three nearest neighbouring wetlands.
* P<.05
** P<.01

pairs and/or broods were found was 11.2 ha. The mean area of open water was 10.5 ha and mean shoreline length was 1.7 km. Mallard pairs and/or broods were significantly associated with wetlands with large open water areas (10.4 ha v.s. 1.8 ha). Ring-necked Duck pairs and/or broods were significantly associated with wetlands with large area (8.3 ha), large area of open water (5.7 ha) and large area of emergents (1.5 ha), relative to the 36 wetlands sampled.

Among the wetlands sampled in the Big Salmon River valley, Green-winged Teal pairs and/or broods were significantly associated with large wetland areas, relative to the wetlands sampled (Table 13). No other duck species were apparently influenced by any of the measured habitat parameters.

Incidental Nest Sites

Although it was not the intention of this study to search out waterfowl nests, a few nests were located. Two Ring-necked Duck nests were recorded in a marsh along the Big Salmon River on June 16. Both were situated in inundated, 90 cm tall *Carex aquatilis*, within an expansive sedge meadow fringed by tall willows.

One Lesser Scaup nest was situated on a floating mat of *Eriophorum* sp., completely surrounded by water, in a bog within the Pelly River valley. On June 23, eight eggs were recorded in the nest. One other Lesser Scaup nest, recorded in a marsh within the Big Salmon River valley was situated in a tussuck of *Carex aquatilis* approximately 30 m from the water's edge. This nest was first located on July 2 with 8 eggs and on July 22 the hen was still sitting on the eggs.

A Trumpeter Swan nest was found in a large wetland in the Big Salmon River valley. The nest was located during the aerial reconnaissance survey in early June and was situated on a muskrat lodge in an extensive stand of emergent *Carex*. On 18 July, 2 adults were observed with 4 cygnets.

TABLE 13 Big Salmon River - Differences in Habitat Parameters Estimates of Wetlands With and Without Pairs and/or Broods, June-July 1982.

HABITAT PARAMETER	WETLANDS WITH PAIRS &/OR BROODS $\bar{X}$	WETLANDS WITHOUT PAIRS &/OR BROODS $\bar{X}$	WILCOXON RANK SUM TEST STATISTIC
Green-winged Teal			
area of wetland (ha)	6.7	4.5	75*
area of open water (ha)	5.2	4.4	83
area of emergents (ha)	0.7	0.7	123
shoreline length (km)	0.8	0.8	106
†proximity to other wetlands (km)	0.2	0.2	110
Mallard			
area of wetland (ha)	6.6	4.5	210
area of open water (ha)	5.1	3.8	208
area of emergents (ha)	0.8	0.4	223
shoreline length (km)	0.9	0.8	204
†proximity to other wetlands (km)	0.2	0.3	152
American Wigeon			
area of wetland (ha)	6.7	4.7	137
area of open water (ha)	5.2	3.8	133
area of emergents (ha)	0.7	0.6	111
shoreline length (km)	0.9	0.8	123
†proximity to other wetlands (km)	0.2	0.2	98
Lesser Scaup			
area of wetland (ha)	7.0	4.6	81
area of open water (ha)	5.8	4.2	98
area of emergents (ha)	0.3	0.7	80
shoreline length (km)	0.7	0.7	78
†proximity to other wetlands (km)	0.3	0.2	95
Bufflehead			
area of wetland (ha)	3.9	5.9	131
area of open water (ha)	2.7	3.9	133
area of emergents (ha)	0.7	0.9	130
shoreline length (km)	0.7	0.8	151
†proximity to other wetlands (km)	0.3	0.2	147

† Mean distance to three nearest neighbouring wetlands.
* $P<.05$

DISCUSSION

Due to the unusually late timing of spring break-up in 1982, the 1982 waterfowl breeding season was consequently atypical, in terms of waterfowl numbers and distribution. King and Conant (1982) conducting the annual spring waterfowl census throughout Alaska and the Old Crow Flats in 1982 found ice break-up was as late as 7-10 days. The Yukon River delta tributaries were flooded unseasonally late, reducing the number of available waterfowl nest sites. Barry (1966) found a relationship between nesting success and snow cover in the spring for northern geese.

Canada Geese

On the three river systems surveyed, Canada Geese were most abundant on the Stewart River. A maximum density of 0.85, 0.32 and 0.02 geese per km of river surveyed was recorded for the Stewart, Pelly and Big Salmon Rivers respectively. These densities represent maximum numbers of approximately 500, 100 and 15 Canada Geese on the three respective rivers. Goose density on the Stewart River compares with Raveling's (1977) estimate of 0.9 Canada Geese/km of the Churchill River.

Canada Geese nested successfully on the Stewart River although only one pair and one family group of 4 adults and 6 young were observed during the two aerial surveys. We found no evidence of Canada Geese breeding on the Big Salmon River; however, the secretive nature of geese suggests adults with broods. Mossop, (pers. comm.) while canoeing down the Nisutlin River in July 1982, noted that adult Canada Geese with broods would rapidly move off the river and into heavy cover at first sight of his canoe. Geese on the Big Salmon River may have moved into heavy cover well ahead of our approach by motorized

canoe since all of the goose sign (feces and tracks) at the four sites on the Big Salmon appeared very fresh. We found no pairs or broods of geese on the Pelly River. Craighead and Craighead (1947) estimated 2.2 Canada Goose nests/mile of the Snake River in Wyoming. Lortie (pers. comm.) counted 12 Canada Goose broods along approximately 150 km of the Nisutlin River, situated in the south-central Yukon, in 1982.

Soper (1954) observed only 2 pairs of Canada Geese in the central Yukon region during his waterfowl reconnaissance in summer 1950, although local residents of Mayo and Dawson told him that fair numbers of Canada Geese nest on the Stewart River and scattered pairs on the Yukon and Big Salmon Rivers. Rand's (1946) summary of the historical records and his own field work in the Yukon suggest Canada Geese breed locally in small numbers from the southern Yukon border to the north coast. Canada Geese broods were recorded this summer in the Lapie Lake region (Dennington pers. comm.) and on the Nisutlin River, (Mossop and Lortie pers. comm.), river systems within the Yukon River Basin east and south of our study area. Overall, historical data and the results of this study suggest that Canada Geese breed in low density within the three river systems of concern.

Although few geese nested on these three river systems, significant numbers of non-breeders occurred on the Pelly and Stewart Rivers. We have circumstantial evidence that at least some of these geese were moulting along the mainstream channels and backwaters. Moulted primary and secondary flight feathers of Canada Geese were found at a number of sites on the Pelly River and a carcass of a flightless goose was found at another backwater. If the timing of the flightless period in geese on these river systems is similar to that of geese moulting on the Copper, Yukon-Kuskokwim and Thelon Rivers, (Bromley 1976, Mickelson 1975, Sterling and Dzubin 1967), then the timing of our aerial and ground surveys would have missed the flightless period of geese on the Stewart and Pelly Rivers. This flightless period occurs for 3 - 4 weeks from early July to early August.

The total number of geese observed on the Stewart River increased seven fold between the June and August surveys while the total number of geese on the Pelly River doubled between the two ground surveys in June and August. We do not know if these population increases happened before or after their annual moult. Non-breeding adult Canada Geese move to specific moulting sites either proximate to their natal areas or hundreds of miles to the north (Bellrose 1976) shortly after the breeding season commences. Geese observed during this study may have moved onto the Stewart and Pelly Rivers in late June before commencing to moult.

Assuming that this influx of geese occurred before the annual moult in July, then from where did these moulting geese originate? Generally, when non-breeding geese move hundreds of miles to the north to moult, they aggregate in areas of large lakes and deltas (Derksen *et al* 1979, Krohn and Bizeau 1979, King and Hodges 1979, Sterling and Dzubin 1967) not river systems like the Stewart and Pelly Rivers. The Stewart and Pelly River systems do not offer prime moulting habitat likely to attract geese from more southerly or Alaskan populations. However, the Stewart and Pelly regions may be important moulting habitat for a local, but widely scattered breeding population of Canada Geese within the central Yukon River Basin.

During moult, geese require a nutritious food source, terrestrial loafing areas with high visibility of the surrounding environ and adjacent waterbodies as escape habitat from potential predators. Backwaters and shore bars, where approximately 90% of the Canada Geese occurred on the Stewart and Pelly River fulfill these requirements.

Backwaters, located in meandering slow moving reaches of rivers, are formed by depositional material in the slack water areas where rivers make acute changes in direction, (Plate 1).

Plate I. Types of Typical Depositional River Bars and Wetlands Found Within the Floodplains of the Pelly and Stewart River Valleys.

Characteristically, they consist of a mud or silt bar enclosing a lagoon of calm water, and open to the river by a narrow deep channel. As water levels drop after spring flood a moderately sloping drawdown zone of mudflats emerges on the river and lagoon side of the bar thus offering an open area with high visibility for geese to loaf. Dense mats of *Equisteum* grow on these mudflats from below the highwater mark up into bordering stands of willow and poplar. Interspersed with the *Equisetum* are small clumps and mats of sedges and on the drier portions of bars, grasses. Vegetation cover in the periphery of the lagoon is similar, however, lagoons at many sites extend fingerlike back into stands of high willow and cottonwood. Shore bars are morphologically similar to backwaters, formed by depositional material along the slackwater side of bends in the river, however, they do not have associated lagoons.

Both backwaters and shore bars are truly riparian in nature. They are annually flooded, scoured by ice and constantly in flux, extending outward as new depositional material is added to bars while the adjacent riverbank is eroded. They are always in the early stages of succession, supporting a unique horsetail, willow and cottonwood plant community.

Equisetum, the dominant plant in backwater and shore bar plant communities is heavily utilized by geese on the Pelly River and likely on the Stewart River. Lortie and Jack (1975) report heavy use of *Equisetum* by geese on the MacMillan and Pelly Rivers during the fall while Prevett *et al* (1979) noted its use by Lesser Snow Geese and Canada Geese in the Hudson's Bay Lowlands during spring migration, the annual moult and during fall migration. Thomas and Prevett (1982) examined the nutritional value of *Equisetum fluviatile* from the Hudson Bay Lowlands. They found that the new growth aerial stems and rhizomes contained 22% and 14% protein content respectively. They concluded that ingested horsetails provide geese with a high protein source, phosphorous and other minerals essential for the development of feather replacement during moult.

In summary, the major habitat requirements for moulting Canada Geese on the Stewart and Pelly Rivers are met by backwaters and shore bars. These two riparian habitats provide wide open loafing areas, slow moving or protected escape waters and a highly nutritious food source in the form of new growth *Equisetum*. These habitats which geese select are most susceptible to alterations in the water level of the active channel. The rich growth of horsetails and sedges on the shore bars and adjacent to backwaters depends on the annual supply of nutrients carried and deposited by the river at high water levels. The subsequent seasonal drop in the river water level enables plant growth, causes the emergence of the bars and thus highly nutritional plant foods are available to geese.

Other Waterfowl

Waterfowl numbers recorded in the Pelly and Big Salmon River valleys may have been atypically low in 1982 due to the apparent unique spring conditions (Johnston *et al* 1982) and because ducks were not displaced north by prairie draught as in past years (King and Conant 1982). King and Conant (1982) in the 1982 waterfowl census of Alaska found nesting dabbler and diver pairs down by as much as 50% from the 10 year average. Russel *et al* (1978) found diver productivity on the Old Crow Flats was strongly correlated with spring break-up.

Waterfowl species composition and abundance on the river channels of the Pelly and Big Salmon Rivers was markedly different. On the Pelly River, over half of the species and 90% of the total number of waterfowl were dabbling ducks while on the Big Salmon River diving ducks species represented over half the species and 80% of the total waterfowl.

Other than one brood of Green-winged Teal in the Big Salmon River, ducks in both rivers' main channels were non-breeders, loafing on open water, on sandbars and in backwaters. The river channels supported breeding populations of Common Mergansers and considerably more on the Big Salmon River than on the Pelly River. As Red-throated Loons nested on river valley wetlands and not along the river channels, their occurrence on the river channels may have been feeding forays (Godfrey 1966).

Generally, species composition was similar for the two river valleys although Arctic Loon occurred only in the Pelly River valley while Common Loon and Trumpeter Swan were recorded only in the Big Salmon River valley. Within both river systems, the most frequently occurring duck species was the Lesser Scaup. Other duck species which frequently occurred on both river systems were Bufflehead, Mallard, Green-winged Teal and American Wigeon. Rand (1946) and Soper (1954) also encountered these species frequently in the southern and central Yukon Territory.

The distribution of waterfowl within the river valleys of the Pelly and Big Salmon Rivers was closely associated with the distribution and abundance of floodplain wetlands. Floodplain wetlands are most abundant on relatively old meandering river systems (Wetzel 1975). Within the Pelly River valley, floodplain wetlands are most abundant upriver of Granite Canyon and upriver of the confluence of the North Big Salmon River in the Big Salmon River valley. The distribution of wetlands is further discussed under Habitat.

The estimated breeding duck pair densities, 44.3 pairs/km^2 of open water in the Pelly River valley and 15.3 pairs/km^2 in the Big Salmon River valley, are low. Danell and Sjoberg (1979) estimated breeding duck density in boreal lakes of coastal Sweden at 54 pairs/km^2, a value beyond our estimates. Although waterfowl

breeding population studies have been conducted in Alaska (King and Conant 1982), the Old Crow Flats (Mossop and Hayes 1977) and the Peace-Athabasca delta (Nieman and Dirschl 1973) no comparable density estimates are available.

The densities of duck pairs, broods and non-breeders were higher on the Pelly River relative to densities on the Big Salmon River. The greatest difference between the rivers was duck pair density. This difference in magnitude may be attributable to the difference in season, relative to duck nesting behaviour, that each river was surveyed. The Pelly River was surveyed (14 - 24 June) during early stages of incubation of divers and mid-stages of incubation of dabblers while the Big Salmon river was surveyed during late incubation stages (26 June - 5 July). As incubation progresses, the drakes leave the incubating hen and flock-up, yet a criteria for a nesting pair is a lone drake. With incubation well advanced few if any lone drakes would be present. As it was with the timing of the breeding pair survey, four dabbler broods were recorded in the Pelly River system and three diver and four dabbler broods were recorded in the Big Salmon River system.

Brood numbers within each river system better reflect waterfowl density. Broods were most abundant within the Pelly River valley (38.3 broods/km^2 vs 26.1/km^2) in which American Wigeon broods, contributing most of the difference, were three times more abundant than in the Big Salmon River valley. Although duck abundance was not extrapolated for the entire area of the river valleys, we would expect a larger population of ducks in the Pelly River system. The Pelly River valley contains 100 more wetlands than on the Big Salmon River and the area of open water or wetlands is larger on average than on the Big Salmon River. Similarly, the duck population along the Stewart River should be very large as at least 900 wetlands occurr within its river valley.

The large numbers of non-breeding ducks occurring on both the wetlands and river channels of both river systems may suggest a poor breeding year for waterfowl. Fewer non-breeding waterfowl were noted during the second surveys down both river systems in July and August both on the river channels and wetlands. Soper (1954) commented on a similar decrease in waterfowl abundance during July and August in the central Yukon. Non-breeding ducks, like geese, move to specific moulting sites sometimes hundreds of miles from their natal areas (Bellrose 1976). Salomonsen (1968) suggested that there was a selective advantage for non-breeding and male ducks to leave the northern breeding grounds, since their absence would decrease the competition for food with the remaining hens and broods. In all our surveys we encountered only 3 ducks in flightless condition and no apparent concentrations of moulting ducks on any of the floodplain wetlands.

Habitat Assessment and Waterfowl Use

The distribution of those wetlands sampled within the river valleys reflects the total distribution of all wetlands within each valley. In the Big Salmon River valley 30% of the 230 wetlands occur within the first 35 km of the river. A similar proportion of the total waterfowl observed were recorded in this region. The Department of Indian and Northern Affairs (1973) identified the first ten linear miles of the river as duck (and geese) breeding area. Theberge *et al* (1980) recommended the same region be protected as an environmentally significant area, one of the criteria being waterfowl nesting and general habitat.

Within the Pelly River valley the wetlands were more variable in their size, shape and area of emergents than in the Big Salmon River valley. Although 57% of the wetlands sampled occurred along an 88 km (22%) stretch of the river between the mouths of the

Earn and MacMillan Rivers, this wetland density was not representative of the distribution of waterfowl. The reason was the occurrence of four large wetlands (12 - 14 ha) of which three were oxbows which accounted for 1/3 of the waterfowl nesting pairs and 2/3's of the broods censused. Each of these four wetlands had a large area of emergent sedges and horsetails. Lortie and Jack (1975) during their ground reconnaissance ecological survey of the Pelly River identified a number of eutrophic oxbows supporting an abundance of waterfowl. They explained the concentrated duck abundance to the well developed areas of emergent *Carex* sp., the eutrophic conditions and the consequent abundance of aquatic invertebrate life. Patterson (1976) studying environmental heterogeneity of waterfowl habitat in central Ontario found that the number of breeding pairs in a wetland was positively correlated with the amount of surface water available.

Most of the wetlands sampled along the Big Salmon River were marshes. No waterfowl species was found to prefer or avoid this wetland class or any other class. In addition, apparently only Green-winged Teal were influenced by any of the habitat parameters measured in their selection of nesting or brood-rearing habitat. In 1982 many of the wetlands along the river were flooded in the spring coincident with the timing in 1982 of nest site selection of ducks. Although flooding is not atypical, the apparent late timing of break-up would presumably have retarded the timing of the river's flooding and thus affected waterfowl distribution and abundance. Flooding may make some wetlands unfavourable to specific waterfowl species by producing an unstable water level or by the inundation of nesting habitat and affecting the area of emergent vegetation relative to the area of open water. Laperle (1974) found that uncontrolled flooding of a natural waterfowl nesting habitat influenced the occurrence of waterfowl and their nest distributions by degrading nesting habitat, reducing the number of nest sites and possibly reducing the food supply or its availability.

Most of the wetlands sampled in the Pelly River valley were shallow waters. No waterfowl species was selective of shallow waters or any other wetland class. Green-winged Teal were recorded on wetlands which were generally larger, had a larger area of open water and a longer shoreline length than wetlands without teal. In contrast, Danell and Sjoberg (1978) found teal broods and pairs on the smallest (.05 ha) of the wetlands sampled. The U.S. Fish and Wildlife Service (1980) in Alaska recognized the different preferences of breeding habitat by Green-winged Teal among different regions of the northern state.

Mallard were generally found associated with wetlands having a large area of open water (10.4 ha) along the Pelly River. Bellrose (1976) described Mallard as catholic in their choice of nest sites and that broods were more tolerant of open water area than were broods of other dabbler species. Mack and Flake (1980) in south Dakota found that larger shoreline lengths were favoured by Mallard broods.

As the Ring-necked Duck nests within the emergent vegetation of a wetland one would expect this species to select for a large area of emergents, as was the case on the Pelly River.

The Bufflehead was the second most abundant brood species in each of the river systems and can be explained by the abundance of Cottonwood, their preferred nesting tree (Erskine 1971, U.S. Fish and Wildlife Service 1980). Rand (1946) found Bufflehead were most abundant in southern and central Yukon in wetlands within mature stands of White Spruce and Cottonwood.

A nesting pair of Trumpeter Swans had previously been reported in the upper reaches of the Big Salmon River (McKelvey *et al* in press).

The most common and abundant emergent plant species of the wetlands sampled in the Pelly and Big Salmon River valleys were *Equisetum fluviatile, Carex aquatilis, Carex rostrata* and *Hippuris vulgaris*. Russell *et al* (1978) found *Carex aquatilis* to provide prime nesting habitat for dive ducks on the Old Crow Flats. *Carex rostrata* and *Equisetum* were also recognized as abundant. Danell and Sjoberg (1978) conducted waterfowl studies in Sweden and found *Eriophorum angustifolum, Carex rostrata* and *Menyanthes trifoliata* to be the most well represented emergent hydrophytes among 97 lakes. *Potamogeton Richardsonii* was the most common and most abundant submergent hydrophyte in the wetlands of the Pelly and Big Salmon Rivers.

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APPENDICES

APPENDIX 1 Raptor Observations on the Pelly and Big Salmon Rivers, June-August 1982.

PELLY RIVER DATE	SPECIES	NO. OF INDIVIDUALS	LOCATION	ACTIVITY
June 19	Northern Goshawk	1 adult	near 115	
June 22	Northern Goshawk	1 adult	near 189	
Aug. 4	Northern Goshawk	1 adult	upriver of 35	flies over river
Aug. 4	Northern Goshawk	1 adult	near 35	flies over river
June 20	Bald Eagle	1 female, 1 young	near 145	nesting, nest 15m up in 20m live spruce with dead top, 20 m from H_2O
Aug. 3	Bald Eagle	1 adult		flies
Aug. 3	Bald Eagle	2 adults	2 km down river of 17	both perched near or on cliff
Aug. 3	Bald Eagle	1 immature		
Aug. 7	Bald Eagle	1 immature	mouth of Earn River	perches on gravel bar
Aug. 7	Bald Eagle	1 immature	near 134	flies from gravel bar
Aug. 7	Bald Eagle	1 female, 1 young	at 145	young in nest, female sits near by
Aug. 10	Bald Eagle	1 adult		moulting primaries, flies
June 19	Golden Eagle	1 pair	2 km downriver of 115	stick nest 1 km back from river, cliff
Aug. 3	Golden Eagle	1 immature	2 km downriver of 17	perch on cliff
June 16 to Aug. 9	American Kestrel	3 male, 7 female 13 unident.		common throughout river valley
Aug. 9	Great Horned Owl	1 adult	176	

APPENDIX 1 - Cont'd.

BIG SALMON RIVER DATE	SPECIES	NO. OF INDIVIDUALS	LOCATION	ACTIVITY
July 2	Bald Eagle	1 female,	downriver of 124	adult flushed off nest, 1 young in nest by shoreline
July 23	Bald Eagle	1 immature 1 adult	142 downriver of 142	no adults of young present perch in spruce by river's edge
July 25	Bald Eagle	1 adult		perch in spruce tree
July 25	Sharp-shinned Hawk	1 adult		
July 24	Northern Goshawk	1 adult	downriver of 188	nest in cottonwood
	Golden Eagle	1 unident.	231	fly overhead
July 3 to July 22	American Kestrel	2 female 2 - 6 unidentified	mostly new water bodies	common throughout river valley
June 28	Merlin	1 adult	13	fly overhead
July 24	Peregrine Falcon	1 adult	mouth of north Big Salmon	flying high to the north
June 30	Great Horned Owl	1 adult	43	rabbit in talons
July 3	Great Horned Owl	1 adult	opposite 174	

APPENDIX 2 **Bird Species Observed During Ground Surveys of the Pelly and Big Salmon Rivers, June-August 1982. Asterisk denotes evidence of breeding; pairs, nests or young of year. Names and order follow convention of AOU, 1982.**

BIRD SPECIES		PELLY RIVER	BIG SALMON RIVER
Red-throated Loon	*Gavia stellata*	⊠*	⊠*
Arctic Loon	*Gavia arctica*	⊠*	
Common Loon	*Gavia immer*		⊠*
Horned Grebe	*Podiceps auritus*	⊠*	⊠*
Red-necked Grebe	*Podiceps grisegena*	⊠*	⊠*
Trumpeter Swan	*Cygnus buccinator*		⊠*
Canada Goose	*Branta canadensis*	⊠	⊠
Green-winged Teal	*Anas crecca*	⊠*	⊠*
Mallard	*Anas platyrhynchos*	⊠*	⊠*
Northern Pintail	*Anas acuta*	⊠*	
Blue-winged Teal	*Anas discors*	⊠*	⊠
Northern Shoveler	*Anas clypeata*	⊠	
American Wigeon	*Anas americana*	⊠*	⊠*
Ring-necked Duck	*Aythya collaris*	⊠*	⊠*
Lesser Scaup	*Aythya affinis*	⊠*	⊠*
Harlequin Duck	*Histrionicus histrionicus*		⊠
Oldsquaw	*Clangula hyemalis*	⊠	
Surf Scoter	*Melanitta perspicillata*	⊠	⊠
White-winged Scoter	*Melanitta fusca*	⊠	
Common Goldeneye	*Bucephala clangula*	⊠*	⊠*
Barrow's Goldeneye	*Bucephala islandica*	⊠*	⊠*
Bufflehead	*Bucephala albeola*	⊠*	⊠*
Common Merganser	*Mergus merganser*	⊠*	⊠*
Bald Eagle	*Haliaeetus leucocephalus*	⊠*	⊠*
Sharp-shinned Hawk	*Accipiter striatus*		⊠
Northern Goshawk	*Accipiter gentilis*	⊠	⊠
Red-tailed Hawk	*Buteo jamaicensis*	⊠	⊠
Golden Eagle	*Aquila chrysaetos*		⊠
American Kestrel	*Falco sparverius*	⊠*	⊠*
Merlin	*Falco columbarius*	⊠	
Peregrine Falcon	*Falco peregrinus*		
Spruce Grouse	*Dendragapus canadensis*	⊠*	
Sora	*Porzana carolina*	⊠	⊠
Semipalmated Plover	*Charadrius semipalmatus*	⊠	⊠
Killdeer	*Charadrius vociferus*	⊠*	⊠
Lesser Yellowlegs	*Tringa flavipes*	⊠*	⊠*
Solitary Sandpiper	*Tringa solitaria*	⊠*	⊠*
Spotted Sandpiper	*Actitis macularia*	⊠*	⊠*
Least Sandpiper	*Calidris minutilla*		⊠
Baird's Sandpiper	*Calidris bairdii*	⊠	⊠
Common Snipe	*Gallinago gallinago*	⊠*	⊠*
Red-necked Phalarope	*Phalaropus lobatus*	⊠	⊠*
Bonaparte's Gull	*Larus philadelphia*	⊠	⊠
Mew Gull	*Larus canus*		⊠

... Cont'd.

APPENDIX 2 - Cont'd.

BIRD SPECIES		PELLY RIVER	BIG SALMON RIVER
Sabine's Gull	*Xema sabini*	■	
Arctic Tern	*Sterna paradisaea*	■	■
Great Horned Owl	*Bubo virginianus*	■	■
Common Night Hawk	*Chordeiles minor*	■	
Belted Kingfisher	*Ceryle alcyon*	■*	■*
Yellow-bellied Sapsucker	*Sphyrapicus varius*		■*
Hairy Woodpecker	*Picoides villosus*		■
Three-toed Woodpecker	*Picoides tridactylus*	■*	■
Northern Flicker	*Colaptes auratus*	■*	■*
Olive-sided Flycatcher	*Contopus borealis*	■	■
Willow Flycatcher	*Empidonax traillii*	■	■
Least Flycatcher	*Empidonax minimus*	■	■
Tree Swallow	*Tachycineta bicolor*	■*	■*
Violet-green Swallow	*Tachycineta thalassina*		■
Bank Swallow	*Riparia riparia*	■*	■*
Cliff Swallow	*Hirundo pyrrhonota*	■*	
Gray Jay	*Perisoreus canadensis*	■*	■*
Common Raven	*Corvus corax*	■*	■*
Boreal Chickadee	*Parus hudsonicus*	■*	■
Red-breasted Nuthatch	*Sitta canadensis*		■
Ruby-crowned Kinglet	*Regulus calendula*	■	■
Swainson's Thrush	*Catharus ustulatus*	■	■
American Robin	*Turdus migratorius*	■	■
Varied Thrush	*Ixoreus naevius*	■	■
Bohemian Waxwing	*Bombycilla garrulus*	■	■
Tenessee Warbler	*Vermivora peregrina*		■
Yellow Warbler	*Dendroica pelechia*	■	■
Yellow-rumped Warbler	*Dendroica coronata*	■	■
Townsend's Warbler	*Dendroica townsendi*		■
Blackpoll Warbler	*Dendroica striata*	■	■
Northern Waterthrush	*Seiurus noveboracensis*	■	
Common Yellowthroat	*Geothlypis trichas*	■	■
Chipping Sparrow	*Spizella passerina*	■	■
Savannah Sparrow	*Passerculus sandwichensis*	■	■
Fox Sparrow	*Passerella iliaca*	■	
Song Sparrow	*Melospiza melodia*	■*	■
Lincoln's Sparrow	*Melospiza lincolnii*	■*	■
White-crowned Sparrow	*Zonotrichia leucophrys*	■	■
Dark-eyed Junco	*Junco hyemalis*	■	■
Red-winged Blackbird	*Agelaius phoeniceus*	■*	■*
Rusty Blackbird	*Euphagus carolinus*	■	■
White-winged Crossbill	*Loxia leucoptera*		■
Pine Siskin	*Cardeulis pinus*		■

APPENDIX 3 Mammal Observations on the Pelly and Big Salmon Rivers, June-August 1982

DATE	PELLY RIVER SPECIES	NO. OF INDIVIDUALS	LOCATION	ACTIVITY
	Least Chipmunk *Eutamias minimus*	present	throughout river valley	
	Arctic Ground Squirrel *Spermophilus parryii*	present	" "	
	Red Squirrel *Tamiasciurus hudsonicus*	abundant	" "	
	Beaver *Castor canadensis*	present	" "	numerous signs (lodges, dams, trailways, feeding piles)
	Muskrat *Ondrata zibethicus*	present		
June 19	Moose *Alces alces*	1 yearling 1 cow, 1 calf	near Earn River	
June 22	Moose	1 yearling	176	

... Cont'd.

APPENDIX 3 - Cont'd

BIG SALMON RIVER DATE	SPECIES	NO. OF INDIVIDUALS	LOCATION	ACTIVITY
	Arctic Ground Squirrel	present		
	Red Squirrel	abundant		
June 27	Beaver	1	near 26	
June 29	Beaver	1	near 35	
July 1	Beaver	1	downriver of 58	swim
July 1	Beaver	1		swim
July 1	Beaver	1	near 121	swim
July 2	Beaver	1	upriver of 121	swim
July 20	Beaver	4	near 56	swim by bank
July 24	Beaver	1 female 1 young	downriver of 118	
June 30	Muskrat	1	30	
July 23	Lynx *Felis canadensis*	1	146	
July 24	Lynx	1	169	flushed female Mallard and brood from emergents.
July 19	Moose	1 yearling	near 33	swim across river
July 19	Moose	1 cow, 1 calf	near 33	standing on bank
July 20	Moose	1 cow, 1 calf	by 58	swim across river
July 21	Moose	1 bull	by 58	3 yr. male swim across river

APPENDIX 4 Number of Waterbirds Recorded on 200 Wetlands Sampled During the Aerial Survey of the Stewart River, 12-13 June 1982.

SPECIES	TOTAL BIRDS	NUMBER OF PAIRS
Red-throated Loon	5	1
Horned Grebe	1	
Swan sp.	1	
Mallard	10	3
American Wigeon	41	5
Unidentified Dabblers	16	3
Dabbler Total	67	11
Scaup spp.	95	14
Goldeneye spp.	18	1
Bufflehead	60	14
Unidentified Divers	16	
Diver Total	189	19
TOTAL WATERBIRDS	263	30

APPENDIX 5 Mean Brood Size of Dabbling and Diving Ducks Observed on the Big Salmon and Pelly Rivers, June-July 1982. Only broods accompanied by adult female and within age classes Ia - IIc considered (Gollop and Marshall 1954).

	BIG SALMON RIVER			PELLY RIVER		
SPECIES	NUMBER OF BROODS	MEAN BROOD SIZE	RANGE OF BROOD SIZES	NUMBER OF BROODS	MEAN BROOD SIZE	RANGE OF BROOD SIZES
Green-winged Teal	8	4.4	2-8	9	4.0	1-8
Mallard	9	4.0	1-9	8	5.0	1-9
American Wigeon	4	6.5	2-9	12	3.5	1-9
Ring-necked Duck	2	7.0	6-8	5	6.0	4-6
Lesser Scaup	1	8.0		4	3.3	2-5
Common Goldeneye	2	6.0	6-6	0		
Bufflehead	9	5.6	3-9	8	4.0	1-7
*Common Merganser	10	7.9	1-18	5	7.4	2-13

* Observed on main channels.

APPENDIX 6 Plant Species Recorded During Ground Surveys on Pelly and Big Salmon Rivers, June-August 1982. Nomenclature follows Porsild and Cody (1980).

PLANT SPECIES	PELLY RIVER	BIG SALMON RIVER
Equisetum arvense	⊠*	
E. fluviatile	⊠*	⊠*
E. pratense		⊠*
Lycopodium annotinum	⊠*	⊠*
Picea glauca	⊠*	⊠*
P. mariana		
Pinus contorta		⊠*
Sparganium angustifolium	⊠*	
S. minimum	⊠*	
Potamogeton alpinus	⊠*	⊠*
P. filiformis	⊠*	⊠*
P. Friesii	⊠*	⊠*
P. gramineus		⊠*
P. pectinatus	⊠*	⊠*
P. praelongus		⊠*
P. pusillus	⊠*	⊠*
P. Richardsonii	⊠*	⊠*
P. vaginatus	⊠*	⊠*
Scheuchzeria palustris	⊠*	
Triglochin maritimum	⊠*	
T. palustre	⊠*	⊠*
Agropyron violaceum	⊠*	
Alopecurus aequalis	⊠*	⊠*
Calamagrostis canadensis	⊠*	⊠*
C. lapponica	⊠*	⊠*
C. neglecta	⊠*	⊠*
Arctophila fulva	⊠*	⊠*
Beckmannia syzigachne	⊠*	
Deschampsia caespitosa	⊠*	
Hordeum jubatum	⊠*	
Poa alpigena	⊠*	⊠*
Glyceria borealis	⊠*	⊠*
G. grandis	⊠*	⊠*
G. pulchella	⊠*	⊠*
Carex aquatilis	⊠*	⊠*
C. aurea	⊠*	⊠*
C. Bigelowii	⊠*	⊠*
C. canescens	⊠*	⊠*
C. chordorrhiza	⊠*	
C. diandra	⊠*	⊠*
C. Garberi	⊠*	⊠*
C. leptalea	⊠*	⊠*
C. limosa	⊠*	⊠*

APPENDIX 6 - Cont'd.

PLANT SPECIES	PELLY RIVER	BIG SALMON RIVER
C. macloviana	■*	■*
C. physocarpa	■*	■*
C. rostrata	■*	■*
Eleocharis acicularis	■*	■*
E. palustris	■*	■*
E. pauciflora	■*	■*
Eriophorum angustifolium	■*	
E. brachyantherum	■*	■*
E. vaginatum	■*	■*
E. viridi-carinatum	■*	■*
Scirpus hudsonianus	■*	■*
S. validus	■*	
Calla palustris	■*	■*
Juncus arcticus	■*	
Juncus balticus	■*	■*
Populus balsamifera	■*	
Salix Farriae	■*	■*
S. glauca	■*	■*
S. longistylis		■*
S. planifolia	■*	■*
Betula glandulosa	■*	■*
B. papyrifera	■*	■*
Geocaulon lividum	■*	
Polygonum alaskanum	■*	■*
P. amphibium	■*	■*
Rumex arcticus	■*	■*
Nuphar polysepalum	■*	
Nuphar variegatum	■*	■*
Ranunculus aquatilis	■*	■*
R. gmelini	■*	■*
R. lapponicus		■*
R. sceleratus	■*	■*
Cardamine pensylvanica	■*	■*
C. pratensis	■*	
Drosera anglica		■*
Fragaria virginiana	■*	
Potentilla arguta	■*	
P. fruticosa	■*	
P. palustris	■*	
Rubus arcticus	■*	
Callitriche hermaphroditica	■*	■*
Epilobium angustifolium		■*
E. glandulosum	■*	■*
E. palustre	■*	■*
Hippuris vulgaris	■*	■*
Myriophyllum exalbescens	■*	■*
M. verticillatum		■*

APPENDIX 6 - Cont'd.

PLANT SPECIES	PELLY RIVER	BIG SALMON RIVER
Cicuta mackensieana	■*	
Cornus canadensis	■*	■*
C. stolonifera	■*	
Pyrola asarifolia		■*
P. grandiflora	■*	■*
Andromeda Polifolia	■*	
Arctostaphylos rubra	■*	
Kalmia polifolia	■*	■*
Ledum groenlandicum	■*	■*
Oxycoccus microcarpus	■*	■*
Vaccinium uliginosum	■*	■*
V. Vitis-idaea	■*	■*
Menyanthes trifoliata	■*	■*
Euphrasia subarctica	■*	
Pedicularis labradorica	■*	■*
Utricularia vulgaris	■*	■*
Linnaea borealis	■*	■*
Viburnum edule	■*	■*